



CLAIMS

1. A catalyst for addition polymerization of olefinically unsaturated

monomers comprising:

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a) a first compound MY wherein M is a transition metal in a low valency state or a transition metal in a low valency state coordinated to at least one coordinating non-charged ligand; and Y is a monovalent, divalent or polyvalent counterion;

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b) an initiator compound comprising a homolytically cleavable bond with a halogen atom; and

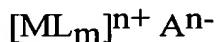
c) an organodiimine, wherein at least one of the nitrogens of the diimine is not part of an aromatic ring.

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2. A catalyst for addition polymerization of olefinically unsaturated

monomers comprising:

d) A first component of Formula



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wherein: M = a transition metal of low valency state

L = an organodiimine where at least one of the
nitrogens of the diimine is not a part of an aromatic ring.

A = an anion

n = an integer of 1 to 3

m = an integer of 1 to 2; and

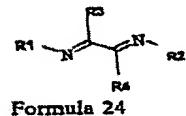
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e) an initiator compound comprising a homolytically cleavable bond with a halogen atom.

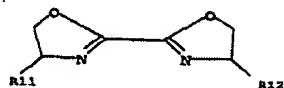
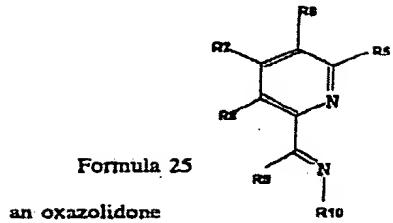
10 3. A catalyst according to any previous claim wherein the organodiimine is selected from the group consisting of:

a 1,4-diaza-1,3-butadiene



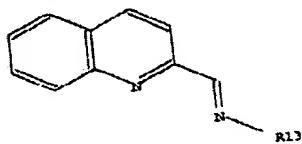
15 a 2-pyridine carbaldehyde imine

a 2-pyridine carbaldehyde imine



Formula 26

or a quinoline carbaldehyde



Formula 27

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wherein:

R₁, R₂, R₁₀, R₁₁, R₁₂ and R₁₃ are independently selectable and may be selected from the group consisting of H, straight chain, branched chain or cyclic saturated alkyl, hydroxyalkyl, carboxyalkyl, aryl, CH₂ Ar, wherein Ar is aryl or substituted or a halogen;

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R₃ to R₉ are independently selectable and may be selected from the group consisting of H, straight chain, branched chain or cyclic alkyl, hydroxyalkyl,

carboxyalkyl, aryl, CH_2Ar , a halogen, OCH_{2n+1} , wherein n is an integer of 1 to 20, NO_2 , CN , $\text{O} = \text{CR}$, wherein R = alkyl, aryl, substituted aryl, benzyl PhCH_2 or a substituted benzyl.

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4. A catalyst according to claim 3 wherein R_1 to R_{13} are selected from the group consisting of C_1 to C_{20} alkyl, C_1 to C_{20} hydroxyalkyl, C_1 to C_{20} carboxyalkyl, n-propylisopropyl, n-butyl, sec-butyl, tert-butyl, cyclohexyl, 2-ethylhexyl, octyldecyl and lauryl.

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5. A catalyst according to claim 3 or claim 4, wherein the organodiimine comprises a chiral center.

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6. A catalyst according to claims 3 to 5 wherein one or more adjacent R_1 and R_3 , R_3 and R_4 , R_4 and R_2 , R_{10} and R_9 , R_8 and R_9 , R_8 and R_7 , R_7 and R_6 , R_6 and R_5 groups are selected from the group consisting of alkyl, cycloalkenyl, polycycloalkyl, polycycloalkenyl and cyclicaryl, containing 5 to 8 carbon atoms.

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7. A catalyst according to any previous claim wherein M is selected from the group consisting of Cu(I), Fe(II), Co(II), Ru(II), Ni(II) Sm(II), Ag(I) and Yb(II).

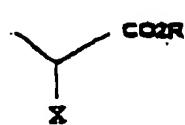
5 8. A catalyst according to any of claims 1 and 3 to 7, wherein Y is selected from the group consisting of Cl, Br, I, NO₃, PF₆, BF₄, SO₄ and CF₃ SO₃, CN, SPh, ScN and SePh.

10 9. A catalyst according to any of claims 2 to 7 wherein A is selected from the group consisting of Cl, Br, F, I, NO₃, SO₄ and CuX₂, wherein X is a halogen.

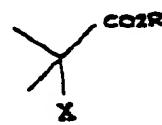
15 10. A catalyst according to claim 1, wherein the initiator is selected from the group consisting of:

RX

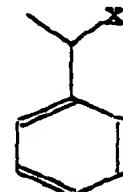
Formula 2,



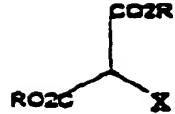
Formula 3,



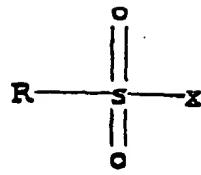
Formula 4,



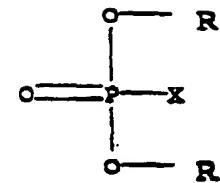
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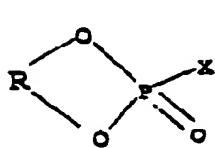
Formula 6,



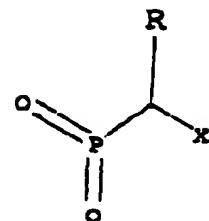
Formula 7,



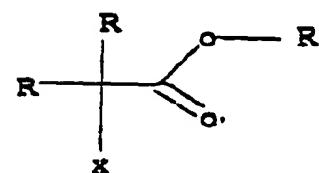
Formula 8,



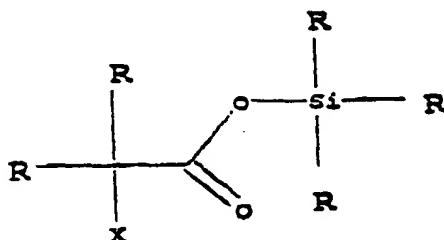
Formula 9,



Formula 10,



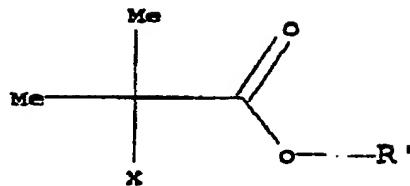
Formula 11, and



Formula 12,

wherein R is independently selectable and is selected from the group consisting of straight chain alkyl, branched chain alkyl, cyclic alkyl, hydrogen, substituted alkyl, hydroxyalkyl, carboxyalkyl, aryl and substituted aryl and substituted benzyl,
 and wherein X = a halide.

11. A catalyst according to claim 10, wherein the initiator is



wherein:

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X = Br, I or Cl, r

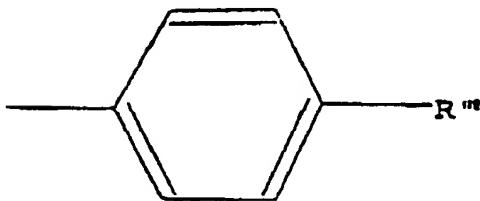
R' = -H,

-(CH₂)_pR'', wherein p is a whole number and R'' = H, OH,

NH₂, SO₃H, COOH, halide, COX, where X is Br, I or Cl,

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or



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R¹¹¹ = -COOH, -COX, where X is Br, I or Cl, -OH, -NH₂ or -SO₃H

12. A catalyst according to claim 11 wherein b is 2-hydroxyethyl-2'-bromopropionate.

5 13. A method for addition polymerization of one or more olefinically saturated monomers comprising:

addition polymerizing one or more olefinically saturated monomers
using the catalyst of claim 1.

10 14. The method according to claim 13, wherein the addition
polymerization is conducted at a temperature between -20°C to 200°C.

15 15. The method according to claim 14, wherein the addition
polymerization is conducted at a temperature between 20°C and 130°C.

20 16. The method according to claim 13, wherein the olefinically saturated monomers are selected from methyl methacrylate, ethyl methacrylate, propyl methacrylate, including all isomers thereof, butyl methacrylate, including all isomers thereof, other alkyl methacrylates, corresponding acrylates, functionalized methacrylates and acrylates,

fluoroalkyl (meth)acrylates, methacrylic acid, acrylic acid, fumaric acid and esters thereof, itaconic acid and esters thereof, nucleic anhydride, styrene, α -methyl styrene, vinyl halides, acrylonitrile, methacrylonitrile, vinylidene halides of formula $\text{CH}_2\text{-C(Hal)}_2$ wherein each halogen is independently Cl or F, optionally substituted butadiene of the formula
5 $\text{CH}_2=\text{C}(\underline{\text{R}_{15}})\text{C}(\underline{\text{R}_{15}})=\text{CH}_2$ wherein $\underline{\text{R}_{15}}$ is independently H, Cl to C10 alkyl, Cl or F, sulphonic acids or derivatives thereof of formula
 $\text{CH}_2=\text{CHSO}_2\text{OM}$ wherein M is NaS, K, Li, $\text{N}(\underline{\text{R}_{16}})_4$, or $-(\text{CH}_2)_2\text{-D}$ wherein
10 each $\underline{\text{R}_{16}}$ is independently H or Cl or C10 alkyl, D is CO_2Z , OH, $\text{N}(\underline{\text{R}_{16}})_2$ or SO_2OZ and Z is H, Li, Na, K or $\text{N}(\underline{\text{R}_{16}})_4$, acrylamide or derivatives
thereof of formula $\text{CH}_2\text{-C(CH}_3\text{)CON}(\underline{\text{R}_{16}})_2$, and wherein mixtures thereof.

17. The use of a catalyst, as defined in claims 1 and 3 to 12, according to
claims 13 to 16, wherein the ratio (c):(a) is 0.01 to 1000 and the ratio of
15 (a):(b) is 0.0001 to 1000.

18. The use of a catalyst as defined in claims 2 to 12 according to claims
13 to 16 wherein the ratio of M:initiator is between 3:1 and 1:100.

20 19. The method according to claim 13, wherein the polymerization is
conducted in water, a protic solvent or a nonprotic solvent.

20. A method for producing a statistical copolymer, a block polymer,
a telechelic polymer or a comb and graft copolymer of monomers, the
method comprising:

producing at least one of a statistical copolymer, a block polymer, a
telechelic polymer and a comb and graft copolymer of monomers using the
catalyst of claim 1.

21. A catalyst for addition polymerization of olefinically unsaturated
monomers comprising:

(a) a first component of formula $(ML_m)^{n+}A^{n-}$ wherein
M = a transition metal of low valency state;
L = an organodiimine where at least one of the nitrogens of the
diimine is not part of an aromatic ring;

A = an anion;
n = an integer from 1 to 3;

m = an integer from 1 to 2; and

(b) an initiator compound comprising a homolytically cleavable
bond with a halogen atom.--

22. A catalyst according to claim 21, wherein A is selected from the group consisting of Cl, Br, F, I, NO₃, SO₄ and CuX₂, wherein X is a halogen.